





Before starting work read these instructions.

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IMI



Change history:

The change history reflects all changes of the Operation & Service Manual, which were done after the initial release.

Index	Chapters	Change description	Date	Name
001	All	New Release	27-Nov-2020	GG
002	All	Minor changes about pictures and texts	25-Jan-2021	GG
003	10	Conformance test record change	4-Feb-2021	GG
004	All	Minor changes to text	23-Mar-2021	JR

This Operation & Service Manual makes no claims of being complete as it does not cover all variants of the VR10 / VR15 valve islands.

Therefore, this document is subject to extensions or changes.





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2 ABOUT THIS DOCUMENTATION

This User Guide contains the information to set up and operate VR10 / VR15 valve island with EtherCAT Interface and to detect and resolve problems.

Note:

In addition to the specific information for the EtherCAT variants, all data sheets and VR10 / VR15 PROTOCOL / MULTIPOLE SERIES IP65 VERSION Operation & Service Manual are applicable and remain valid.

Refer also to the data sheets on the following web link:

https://www.norgren.com

Refer also to the valve island installation instruction in the following document:

- "VR10 / VR15 PROTOCOL / MULTIPOLE SERIES IP65 VERSION Operation & Service Manual"
 - This manual can be found on https://www.norgren.com/uk/en/technical-support/installation-maintenance-instructions/valves

Basic information about EtherCAT can be found in the following documents:

- https://www.ethercat.org/download/documents/ETG Brochure EN.pdf
- <u>https://www.ethercat.org/download/documents/EtherCAT_Device_Protocol_Poster.pdf</u>

Installation guideline and diagnosis manual about EtherCAT can be found in the following documents:

- https://www.ethercat.org/download/documents/ETG1600 V1i0i2 G R InstallationGuideline.pdf
- https://www.ethercat.org/download/documents/EtherCAT_Diagnosis_For_Users.pdf

Further information about EtherCAT is available on ETG websites:

- https://www.ethercat.org
- https://www.ethercat.org/en/technology.html
- https://www.ethercat.org/en/downloads.html





3 IMPORTANT HINTS

3.1 GROUNDING AND EQUIPOTENTIAL BONDING

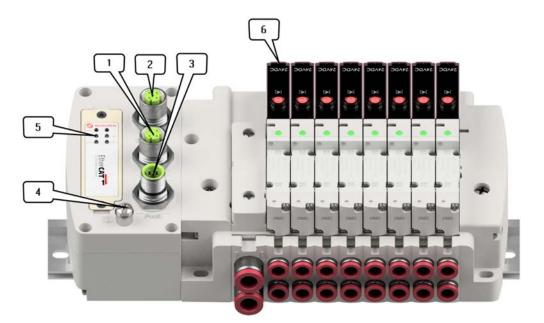
Proper grounding and equipotential bonding are very important to protect against electromagnetic interferences in EtherCAT networks. In order to reduce potential impact, grounding of the EtherCAT cable screen should be done at both ends of every cable (i.e. at each device). Equipotential bonding ensures that the ground potential is identical throughout the entire EtherCAT network and is essential to avoid equipotential bonding currents, which can otherwise flow through the EtherCAT cable screen. Please refer for further details to the "ETG.1600 EtherCAT Installation Guide" provided by the EtherCAT user organization ETG (https://www.ethercat.org).

For proper grounding please use the earth screw (M4) on the upper side of the valve island. For easy reference see item 4 in chapter 4.





4 ELECTRICAL CONNECTIONS



- 1- Port 1: BUS IN for EtherCAT (M12 x 1 | Female | 4 – pin | D – coded)
- 2- Port 2: BUS OUT for EtherCAT

(M12 x 1 | Female | 4 - pin | D - coded)

- 3- PWR: Power Supply to Control Module and Valves
 (M12 x 1 | Male | 5 pin | A coded)
- 4- Earth screw (M4)
- 5- Status LEDs
- 6- Valve status LEDs



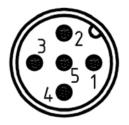


4.1 EtherCAT PORT 1 & PORT 2

	M12 / 4 pins	/ Female Connector / D-coded
$\mathcal{C} O^2 \mathcal{N}$	Pin No.	Function
	1	Transmission Data + (TD +)
	2	Receive Data + (RD +)
\\ 40 <i>"</i> //	3	Transmission Data - (TD -)
	4	Receive Data - (RD -)

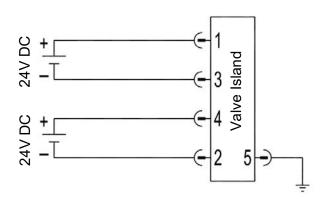
4.2 POWER SUPPLY CONNECTOR

Pin allocating of power supply connector



M12 / 5 pins / Male Connector / A-coded					
Pin No.	Function				
1	L1 (VB +) 24V electronics power supply				
2	N2 (VA -) 0V valves power supply				
3	N1 (VB -) 0V electronics power supply				
4	L2 (VA +) 24V valves power supply				
5	FE (functional earth)				

Power supply wiring diagram



Notes:

- Make sure electronics power, valves power and their polarities are connected to correct pins respectively before switching on.
- Select the appropriate cables to mate with the connectors mounted on the control module.
- Connect the earth screw to ground.





4.3 ELECTRICAL DATA

Specification	Specification							
Valve voltage range (VA)	24VDC +10%/-5%	PELV						
Electronics voltage range (VB)	24VDC +/-10%	PELV						
Maximum currents	VA: n × 40 mA VB: < 100 mA	n = number of solenoids						
Voltages are galvanic decoupled	Yes							
Protection against polarity reversal	Yes							
Overcurrent protection VB, VA	Irreversible							
Output polarity	PNP							



5 SOLENOID NUMBER, OUTPUT POINT & VALVE STATION MAPPING

5.1 MAPPING RULES FOR VALVE STATIONS \leq 12

 If valve stations ≤ 12, 2 solenoid numbers are always reserved for each valve station. * Detailed allocation is shown as below:

Station	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12
Solenoid A	Sol.01	Sol.03	Sol.05	Sol.07	Sol.09	Sol.11	Sol.13	Sol.15	Sol.17	Sol.19	Sol.21	Sol.23
(14 Solenoid)	Output 0	Output 2	Output 4	Output 6	Output 8	Output 10	Output 12	Output 14	Output 16	Output 18	Output 20	Output 22
Solenoid B	Sol.02	Sol.04	Sol.06	Sol.08	Sol.10	Sol.12	Sol.14	Sol.16	Sol.18	Sol.20	Sol.22	Sol.24
(12 Solenoid)	Output 1	Output 3	Output 5	Output 7	Output 9	Output 11	Output 13	Output 15	Output 17	Output 19	Output 21	Output 23

Notes:

* For valve station with single solenoid, only Solenoid A (14 Solenoid) is connected. Consider the one which is closest to control module as 1st station (Station #1)

5.2 MAPPING RULES FOR 12 < VALVE STATIONS \leq 24

- If 12 < valve stations ≤ 24, special rules are required since only 1 solenoid number is allocated to valve station with single solenoid:</p>
 - Sequence all solenoids following the rules below by starting from 1st station which is the station closest to control module:
 - If 1st station is with double solenoids, sequence solenoid A as Sol.01, solenoid B as Sol.02, following 2nd station solenoid A as Sol.03, solenoid B as Sol.04.....
 - If 1st station is with single solenoid, sequence solenoid A as Sol.01, following 2nd station solenoid A as Sol.02, solenoid B as Sol.03.....
 - o If a station is originally configured as blank, always 2 solenoid numbers are allocated.
 - $\circ~$ The rest of stations should also adhere to the sequence rules above.
 - A 16-station 24 solenoids valve island example is shown below:

	Double Solenoids	Double Solenoids	Single Solenoid	Single Solenoid	Double Solenoids	Double Solenoids	Single Solenoid	Double Solenoids	Single Solenoid	Double Solenoids	Single Solenoid	Double Solenoids	Single Solenoid	Single Solenoid	Double Solenoids	Single Solenoid
Station	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16
Solenoid A	Sol.01	Sol.03	Sol.05	Sol.06	Sol.07	Sol.09	Sol.11	Sol.12	Sol.14	Sol.15	Sol.17	Sol.18	Sol.20	Sol.21	Sol.22	Sol.24
(14 Solenoid)	Output 0	Output 2	Output 4	Output 5	Output 6	Output 8	Output 10	Output 11	Output 13	Output 14	Output 16	Output 17	Output 19	Output 20	Output 21	Output 23
Solenoid B	Sol.02	Sol.04			Sol.08	Sol.10		Sol.13		Sol.16		Sol.19			Sol.23	
(12 Solenoid)	Output 1	Output 3	*	*	Output 7	Output 9	*	** Output 12	ut*	Output 15	*	Output 18	*	*	Output 22	*

Note:

* For valve station with single solenoid, only Solenoid A (14 Solenoid) is allocated & connected. Consider the one which is closest to control module as 1st station (Station #1).





6 COMMISSIONING

Notes:

 The method of EtherCAT module installation strongly depends on the configuration software. Please refer to the configuration software manual, all examples in this document are made with Beckhoff PLC CX5130-0125 and TwinCAT v3.1.4024.7.

6.1 ESI FILE INSTALLATION

A device description file is needed for configuration of valve island. The ESI (EtherCAT Slave Information) file is an XML based file and can be used for all variants VR10 / VR15:

<u>"NORGREN-VR1X-EC-Vxx-JJJJMMDD.xml"</u>

Note: "JJJJMMDD" (JJJJ-year, MM-month, DD-day) is date of release, "Vxx" is version number of the file.

The ESI file must be put into the following folder before starting TwinCAT software:

<u>C:\TwinCAT\3.1\Config\lo\EtherCAT</u>

Beckhoff FM3xxx.xml Beckhoff ILxxxx-B110.xml	2018/6/29 15:05 2015/2/4 12:57	XML 文档 XML 文档	367 KB 8 KB
Beckhoff FCxxxxxml	2015/2/4 12:57	XML文档	21 KB
Beckhoff FB1XXX.xml	2017/5/24 12:26	XML 文档	49 KB
Beckhoff EtherCAT Terminals.xml	2015/2/4 12:57	XML 文档	53 KB
Beckhoff EtherCAT EvaBoard.xml	2015/2/4 12:57	XML 文档	72 KB
Beckhoff ER8xxx.xml	2016/3/14 11:52	XML文档	207 KB
Beckhoff ER7xxx.xml	2019/2/14 8:50	XML文档	2,717 KB
Beckhoff ER6xxx.xml	2016/3/14 11:52	XML文档	494 KB
Beckhoff ER5xxx.xml	2016/3/14 11:52	XML文档	273 KB
Beckhoff ER4xxx.xml	2016/11/22 12:58	XML文档	318 KB
Beckhoff ER3xxx.XML	2017/6/9 13:35	XML文档	1,177 KB
Beckhoff ER2xxx.XML	2016/11/21 14:32	XML文档	259 KB
Beckhoff ER1xxx.XML	2020/1/23 9:07	XML文档	269 KB
Beckhoff EQ3xxx.xml	2016/11/22 11:22	XML文档	1,386 KB
Beckhoff EQ2xxx.xml	2016/11/23 10:42	XML文档	73 KB
Beckhoff EQ1xxx.xml	2015/11/12 14:24	XML文档	22 KB
Beckhoff EPx9xx.xml	2019/11/19 8:25	XML文档	629 KB
Beckhoff EPP9xxx.xml	2019/10/15 14:54	XML文档	197 KB
Beckhoff EPP7xxx.xml	2019/11/25 11:36	XML 文档	2,215 KB
Beckhoff EPP6xxx.xml	2019/5/29 10:27	XML文档	1,300 KB
Beckhoff EPP5xxx.xml	2018/10/16 14:34	XML 文档	779 KB
Beckhoff EPP4xxx.xml	2016/12/22 10:57	XML文档	500 KB
Beckhoff EPP3xxx.xml	2019/3/4 14:14	XML文档	2,317 KB
Beckhoff EPP2xxx.xml	2019/7/31 21:43	XML 文档	1,871 KB
Beckhoff EPP1xxx.xml	2019/11/20 11:01	XML 文档	521 KB
S称	修改日期	类型	大小

Note: If putting the ESI file into the folder when TwinCAT is running, you must restart TwinCAT to update hardware catalog.

The ESI file is available from the following web link:

https://www.norgren.com/uk/en/technical-support/software





6.2 HARDWARE CONFIGURATION

After the successful installation of the ESI file the VR10 / VR15 is listed in the hardware catalogue.

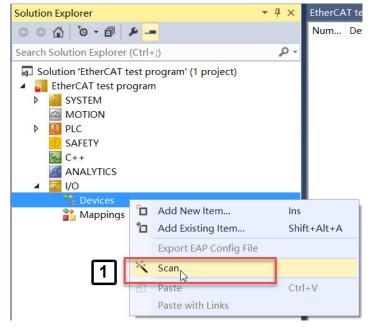
ch:		Name:	Box 1	Multiple	: 1	ОК
ia-⊷ Nor ia-≫ Nor	khoff Automation Gr gren Manufacturing /alve Island VR seri ତ VR1X-EC	Co., Ltd.	KG			Cancel Port A D B (Ethernet) C
Extende	d Information		Show Hidden	n Devices	🗸 Sh	ow Sub Groups

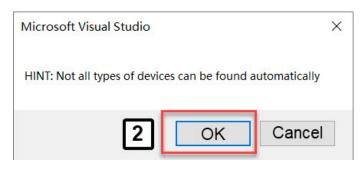




6.2.1 Configuration by "Scan" Option (Recommended)

- Connect valve islands to the PLC and power on, make sure the engineering tool connects to PLC.
- In the engineering tool, right click "Devices" in the I/O tree and select "Scan". (Tag 1)



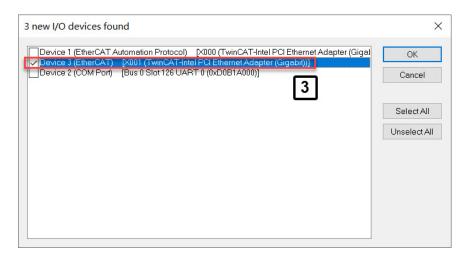


 Click the "OK" button on the popup window. (Tag 2)





- Select the Device and Ethernet Adapter that is connected to the valve island. (Tag 3)
- Click "OK". (Tag 4)
- Click "YES" button on popup window. (Tag 5)



Microsoft Visual Stu	udio X	Microsoft Visual S	Studio X
? Scan for bo	oxes	? Activate	Free Run
YES	NO	YES	NO





- After successfully finishing the scan, both the EtherCAT Master and the valve island are listed in the I/O tree.
- Click EtherCAT Master and rename it as required. (Tag 6-7)
- Click valve island and rename it as required. (Tag 8-9)

Solution Explorer	• ₽ ×	EtherCAT test program 😕 🗙
Search Solution Explorer (Ctrl+;)	- م	General Adapter EtherCAT Online CoE - Online Name: CX5130-0125 7 Id: 3
EtherCAT test program Gamma System MOTION MOTION MOTION		Object Id: 0x03010030 Type: EtherCAT Master
SAFETY SAFETY ANALYTICS ANALY		Comment:
 Image Image-Info SyncUnits Inputs InfoData Son 1 (VR1X-EC) Mappings 		Disabled Create symbols

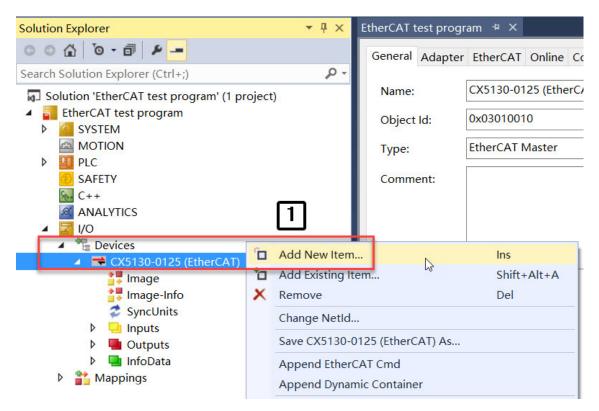
Solution Explorer 👻 🖣 🗙	EtherCAT test program 💠 🗶
○ @ o - @ <u>+</u> -	General EtherCAT DC Process Data Plc Startup CoE - Online Online
Search Solution Explorer (Ctrl+;)	Name: VR10-EC J Object Id: 0x03020001 Type: VR1X-EC Comment:
Curputs Social Control Contro	





6.2.2 Configuration by "Add New Item" Option

• Right click the existing master and select "Add New Item". (Tag 1)







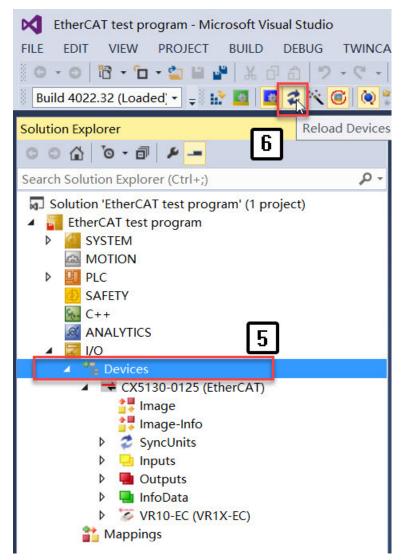
- Select "VR1X-EC" in Norgren Manufacturing CO., Ltd. tree to add valve island. (Tag 2)
- Rename valve island as required. (Tag 3)
- Set valve island quantities that need to be added in the Multiple cell. (Tag 4)

Insert Eth	erCAT Device			×
Search:	Name:	VR10-EC	Multiple: 1 📑	ок
Type:	Beckhoff Automation GmbH & C Norgren Manufacturing Co., Ltd. Valve Island VR series VRIX-EC	o. KG	4	Cancel Port A D B (Ethernet) C
	Extended Information	Show Hidden Device	s 🗹 Sh	ow Sub Groups





- Make sure all valve islands are connected to PLC and power on.
- Click "Devices" in I/O tree. (Tag 5)
- Click "Reload Devices" button to make valve islands online. (Tag 6)

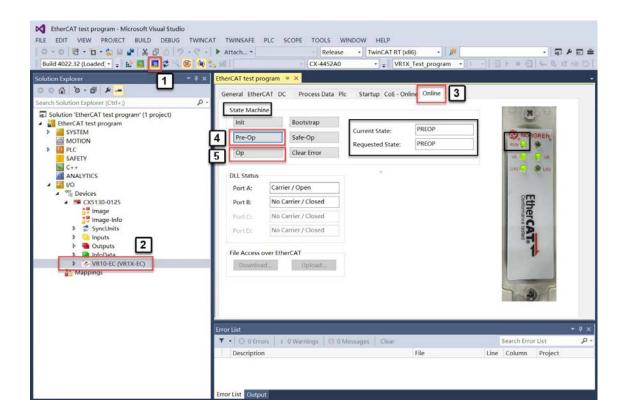






6.2.3 Identifying Valve Islands in Network

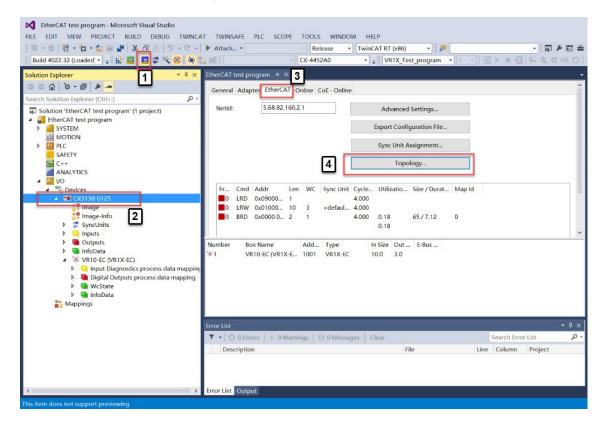
- Blink Test
 - Blinking Run LED can help to identify valve islands in the network.
 - Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
 - Set PLC to Config Mode. (Tag 1)
 - Click the one valve island that you want to identify in the I/O tree. (Tag 2)
 - Open "Online" at the right side. (Tag 3)
 - Click "Pre-Op" button in State Machine, make sure the current state is "PREOP". (Tag 4)
 - Run LED will be blinking slowly, and this blinked valve island is the one identified.
 - After Identifying, click "Op" button in State Machine, to reset the current state to "OP" before driving valve islands. (Tag 5)
 - Repeat the steps to identify other valve islands.







- Topology view
 - Topology view also can help to identify valve islands in the network more directly.
 - Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
 - Set PLC to Config Mode. (Tag 1)
 - Click EtherCAT Master in I/O tree. (Tag 2)
 - Open "EtherCAT" at the right side. (Tag 3)
 - Click "Topology" button to open topology view. (Tag 4)
 - Tick "Show Topology" in Online menu. (Tag 5)
 - Click one positioning valve island icon in topology view. (Tag 6)
 - Find unique valve island name in the dialogue. (Tag 7)
 - Repeat the steps to identify other valve islands.







Topology 5	
View Offline Online Show Topology Compare To	
Topology	- 🗆 X
View Offline Online	Online Configuration
	EtherCAT Online Process Data Name: 7 Type: VR10-EC (VR1X-EC) Type: VR1X-EC EtherCAT Addr. 1001
	Auto Inc Addr: 0 Identity





6.3 **PARAMETERIZATION**

6.3.1 DC (Distributed Clock) Operation Mode Setting

VR10 / VR15 valve island supports DC operation mode.

- Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
- Set PLC to Config Mode. (Tag 1)
- Click valve island in I/O tree. (Tag 2)
- Open "Online" at the right side.
- Click "Pre-Op" button to set valve island to PREOP state. (Tag 3)
- Open "DC" tab.
- Select Operation Mode to DC-Synchron. (Tag 4)
- After successful setting, valve island will work under DC-Synchron mode.

EtherCAT test program - Microsoft Visual Studio FILE EDIT VIEW PROJECT BUILD DEBUG TWINCAT O <t< th=""><th>Attach •</th><th>SCOPE TOOLS W - Release - CX-4452A0</th><th>INDOW HELP - TwinCAT RT (x8 - = VR1X</th><th>16) • 🔎 • 🗐 🕹 🖬 🖉 🕯 🖉 🖛</th></t<>	Attach •	SCOPE TOOLS W - Release - CX-4452A0	INDOW HELP - TwinCAT RT (x8 - = VR1X	16) • 🔎 • 🗐 🕹 🖬 🖉 🕯 🖉 🖛
Solution Explorer Search Solution Explorer (Ctrl+:) Solution 'EtherCAT test program' (1 project) Solution 'EtherCAT test program Solution 'EtherCAT test program	Port B: No C		: Startup CoE - Onli Current State: Requested State:	PREOP PREOP
Outputs O	EtherCAT test program General EtherCAT DC Operation Mode:	_	DC-Synchron	une Online





6.3.2 Cycle Counter Setting and Resetting

VR10 / VR15 valve island supports cycle counting, count limit set and counter reset for each solenoid.

- Cycle counting
 - Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
 - Click valve island in I/O tree. (Tag 1)
 - Open "Online" tab and make sure current state is "OP" or "PREOP". (Tag 2-3)
 - Open "CoE-Online" tab and make sure no tick "Show Offline Data". (Tag 4-5)
 - Make sure "Online Data" activated. (Tag 6)
 - Expand Index "2000:0" and find the cycle value for each solenoid. (Tag 7)
 - Solenoid number, output point and valve station mapping relation see Chapter 5.
 - The value displays in hexadecimal and decimal. (Tag 8)
 - Double click specified solenoid and find the decimal cycles in first row. (Tag 9)

				Init Pre-Op	Bootstrap Safe-Op	Current State:	OP
				Ор	Clear Error	Requested State:	OP 3
olution Explorer	• 4 ×	EtherCAT test progr	am + ×			5	
00000-0-0-		General EtherCA	T DC Process Data Plc	Canada Co	E - Online Online		
earch Solution Explorer (Ctrl+;)	ρ.	General EtherCA	I DC Process Data Pic	4	De - Onime Onime	_	
Solution 'EtherCAT test program' (1 pro		Update	List Auto Upd	ate Single	Update Show Off	ne Data 5	
EtherCAT test program	ojeci)						
SYSTEM		Advance	d				
MOTION		Add to Sta	rtup Online Data	6	odule OD (AoE Port):	0	
PLC							
SAFETY		Index	Name	Flags	Value	Unit	-
G C++		+ 1C33:0	SM input parameter	7	> 32 <		
		= 2000:0		7	> 24 <	8	
Pevices		2000:01	Output 0 Switching Cycle		0x00000052 (82) 0x00000053 (83)	0	
 CX5130-0125 		2000:02 2000:03	Output 1 Switching Cycle Output 2 Switching Cycle		0x00000053 (83) 0x00000052 (82)	Set Value Dialog	6
📑 Image		2000:04	Output 3 Switching Cycle		0x00000053 (83)		9
📑 Image-Info		2000:05	Output 4 Switching Cycle		0x00000052 (82)	Dec. 82	OK
SyncUnits		2000:06	Output 5 Switching Cycle		0x00000053 (83)	Hex: 0x0000052	Cence
P inputs	_	2000:07	Output 6 Switching Cycle		0x00000052 (82)	Float [11490647e-43	
D Utputs	1	2000:08	Output 7 Switching Cycle		0x00000053 (83)		
VR10-EC (VR1X-EC)		2000:09	Output 8 Switching Cycle	s RO	0x00000052 (82)	Bool: 0 1	Hex Ed
Mappings		2000:0A	Output 9 Switching Cycle	s RO	0x00000053 (83)	Binary: 52 00 00 00	4
a meppings		2000:0B	Output 10 Switching Cyc	es RO	0x00000052 (82)	BrSize O1 O8 O16	32 O64 O7
		2000:0C	Output 11 Switching Cyc	es RO	0x00000053 (83)		
		2000:0D	Output 12 Switching Cyc	es RO	0x00000052 (82)		
		2000:0E	Output 13 Switching Cyc		0x00000053 (83)		
		2000:0F	Output 14 Switching Cyc		0x00000052 (82)		
		2000:10	Output 15 Switching Cyc		0x00000053 (83)		
		2000:11	Output 16 Switching Cyc		0x00000052 (82)		
		2000:12	Output 17 Switching Cyc	es RO	0x00000053 (83)		
		2000:13	Output 18 Switching Cyc	es RO	0x00000052 (82)		





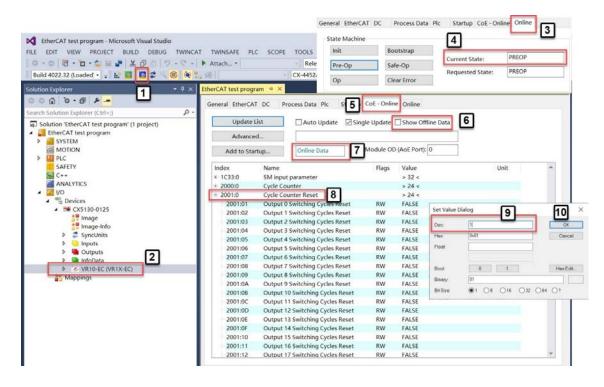
- Count limit set
 - Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
 - Set PLC to Config Mode. (Tag 1)
 - Click valve island in I/O tree. (Tag 2)
 - Open "Online" tab and make sure current state is "PREOP". (Tag 3-4)
 - Open "CoE-Online" tab and make sure no tick "Show Offline Data". (Tag 5-6)
 - Make sure "Online Data" activated. (Tag 7)
 - Expand Index "8000:0" and find the cycle counter limit value for each solenoid. (Tag 8)
 - Solenoid number, output point and valve station mapping relation see Chapter 5.
 - The value displays & set in hexadecimal and decimal.
 - Double click specified solenoid and input the decimal cycles limit as required in first row. (Tag 9-10)
 - The max. limit is 0xFFFFFFF in hexadecimal.
 - If the count cycles are beyond the count limit, an EtherCAT cycle overrun diagnostic with error code and channel number appears. This diagnostic function cannot be disabled.

EtherCAT test program - Microsoft Visual Studio			State Machine		4		
ILE EDIT VIEW PROJECT BUILD DEBUG TV	WINCAT TWINSAFE PL	C SCOPE TOOLS	Init	Bootstrap	Current State:	PREOP	
0-0 8-0- <u>2</u> 8 - <u>7</u> 0 7-1	🤄 - 🕨 Attach +	Rele	Pre-Op	Safe-Op			
Build 4022.32 (Loaded • 🖕 🔛 🛄 💆 🖉 🤘	(a) 2. sti	- CX-4452			Requested State:	PREOP	
olution Explorer	× EtherCAT test progr	ram + ×	Ор	Clear Error			
	General EtherCA	T DC Process Data		- Online Online			
arch Solution Explorer (Ctrl+;)	p.		Pic 5 5				
Solution 'EtherCAT test program' (1 project)	Update I	List 🗌 Auto I	Ipdate Single U	Ipdate Show Offlin	e Data 6		
EtherCAT test program							
SYSTEM	Advance	d					
MOTION	Add to Sta	rtup Online D	ata 7 Mo	dule OD (AoE Port): 0			
P III PLC							
SAFETY	Index	Name	Flags	Value	Unit		
6- C++	+ 7000:0	Digital Outputs		>3<			
ANALYTICS	- 8000:0	Cycle Counter Limit	8	> 24 <			
🔺 🔜 VO	8000:01	Output 0	RW	OxFFFFFFFF (-1)			
 Devices 	8000:02	Output 1	RW	OxFFFFFFFF (-1)	1		
 CX5130-0125 	8000:03	Output 2	RW	OxFFFFFFFF (-1)	Set Value Dialog	1	10
🚰 Image	8000:04	Output 3	RW	OxFFFFFFFF (-1)			-
🚼 Image-Info	-8000:05	Output 4	RW	OxFFFFFFFF (-1)	Dec: 4294967295	*	0
SyncUnits	8000:06	Output 5	RW	OxFFFFFFFF (-1)	Hex 0xFFFFFFF	Ŧ	Cer
P linputs	8000:07	Output 6	BW	OxFFFFFFFF (-1)	Float -nan.0		
Dutputs	8000:08	Output 7	RW	OxFFFFFFFF (-1)	Float -nan.0		
A InfoData	8000:09	Output 8	RW	OxFFFFFFFF (-1)			
VR10-EC (VR1X-EC)	8000:0A	Output 9	RW	OxFFFFFFFF (-1)	Book 0	1	Hex
Mappings	8000:0B	Output 10	RW	OxFFFFFFFF (-1)	Binary FF FF FF FF		
	8000:0C	Output 11	RW	OxFFFFFFFF (-1)	Binary: FF FF FF FF		
	8000:0D	Output 12	RW	0xFFFFFFFF (-1)	Bit Size: 01 08	0 16 @ 32 ()64 ()7
	8000:0E	Output 13	RW	OxFFFFFFFF (-1)			
	8000:0E	Output 14	RW	OxFFFFFFFF (-1)			
	8000:10	Output 15	RW	OxFFFFFFFF (-1)			
	8000:11	Output 16	RW	OxFFFFFFFF (-1)			
	8000:12	Output 17	RW	OxFFFFFFFF (-1)			





- Counter Reset
 - Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
 - Set PLC to Config Mode. (Tag 1)
 - Click valve island in I/O tree. (Tag 2)
 - Open "Online" tab and make sure current state is "PREOP". (Tag 3-4)
 - Open "CoE-Online" tab and make sure "Show Offline Data" is not checked. (Tag 5-6)
 - Make sure "Online Data" activated. (Tag 7)
 - Expand Index "2001:0" and find cycle reset for each solenoid. (Tag 8)
 - Solenoid number, output point and valve station mapping relation see Chapter 5.
 - Double click specified solenoid and input "1" in first row. (Tag 9)
 - Click "OK" button and reset counter to zero. (Tag 10)



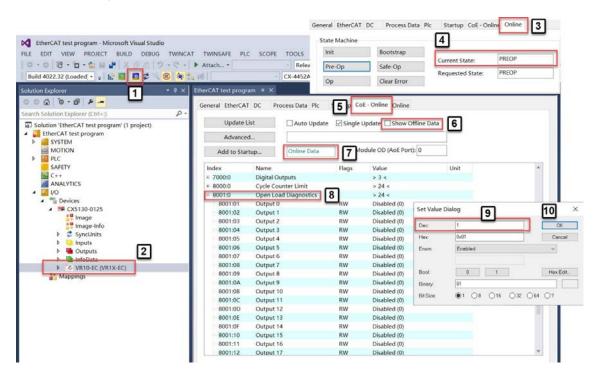




6.3.3 Open Load Diagnostics Setting

It is possible for VR10 / VR15 valve island to enable / disable the open load diagnostics for each solenoid. If disabled, no EtherCAT open load diagnostic error code appears. Otherwise an EtherCAT channel diagnostic with error code and channel number appears.

- Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
- Set PLC to Config Mode. (Tag 1)
- Click valve island in I/O tree. (Tag 2)
- Open "Online" tab and make sure current state "PREOP". (Tag 3-4)
- Open "CoE-Online" tab and make sure no tick "Show Offline Data". (Tag 5-6)
- Make sure "Online Data" activated. (Tag 7)
- Expand Index "8001:0" and find open load set for each solenoid. (Tag 8)
- For solenoid number, output point and valve station mapping relationships see Chapter 5.
- Double click specified solenoid and input "1" in first row. (Tag 9)
- Click "OK" button and enable the open load diagnostics. (Tag 10)
- To disable the open load diagnostics, input "0" in first row.
- Default setting for all solenoids is disabled.



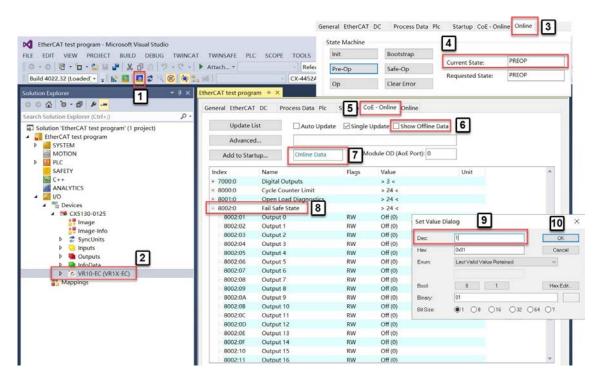




6.3.4 Fail Safe State Setting

It is possible to define the behaviour of the outputs in case of broken EtherCAT communication. The following two states can be defined by the outputs:

- 1) Output Off
- 2) Output Last Valid Value Retained
- Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
- Set PLC to Config Mode. (Tag 1)
- Click valve island in I/O tree. (Tag 2)
- Open "Online" tab and make sure current state is "PREOP". (Tag 3-4)
- Open "CoE-Online" tab and make sure "Show Offline Data" is not checked. (Tag 5-6)
- Make sure "Online Data" activated. (Tag 7)
- Expand Index "8002:0" and find fail safe state set for each solenoid. (Tag 8)
- For solenoid number, output point and valve station mapping relationships see Chapter 5.
- Double click specified output and input "1" in first row. (Tag 9)
- Click "OK" button and set fail safe state to "Last Valid Value Retained". (Tag 10)
- To set fail safe state to "Off", input "0" in first row.
- Default setting for all outputs is "Off".







6.3.5 Voltage and Short Circuit Diagnostics

VR10 / VR15 valve island supports voltage diagnostics for both electronic power and valve power and short circuit diagnostics for each solenoid. These two diagnostic functions cannot be disabled.

- In case of over / under voltage an EtherCAT module diagnostic with error code appears and the related LEDs on the valve island change colour from green to red.
- In case of short circuit an EtherCAT channel diagnostic with error code and channel number appears.



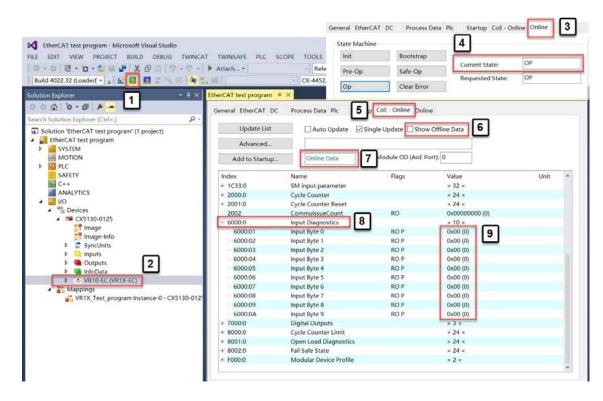


7 **DIAGNOSTICS**

7.1 DIAGNOSTICS INFORMATION PORTAL

7.1.1 CoE-Online Portal

- Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
- Set PLC to Run Mode. (Tag 1)
- Click valve island in I/O tree. (Tag 2)
- Open "Online" tab and make sure current state "OP". (Tag 3-4)
- Open "CoE-Online" tab and make sure no tick "Show Offline Data". (Tag 5-6)
- Make sure "Online Data" activated. (Tag 7)
- Expand Index "6000:0" and find all diagnostics information, all error codes will be reported here from "Input Byte 0" to "Input Byte 9". (Tag 8-9)

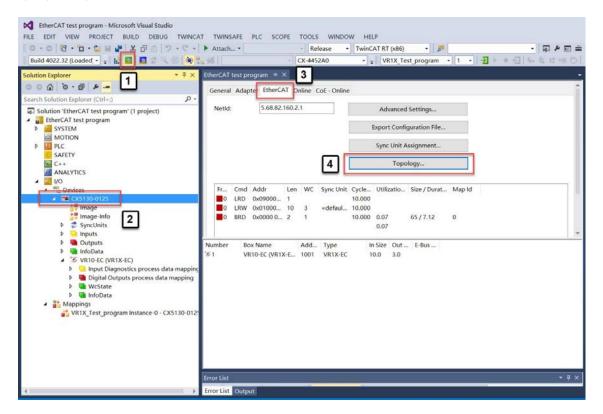






7.1.2 Topology View Portal

- Make sure all valve islands are all online, if offline please refer to Section 6.2.2, "Reload Device" step.
- Set PLC to Run Mode. (Tag 1)
- Click EtherCAT Master in I/O tree. (Tag 2)
- Open "EtherCAT" tab at the right side. (Tag 3)
- Click "Topology" button to open topology view. (Tag 4)
- Tick "Show Topology" in Online menu. (Tag 5)
- Click on valve island icon in topology view.
- Open "Online" tab and make sure current state "OP". (Tag 6-7)
- Open "Process Data" tab to see all diagnostics information. All error codes will be reported here from "Input Byte 0" to "Input Byte 9" in Input Diagnostics process data mapping list. (Tag 8-10)







Topology 5	E 6 AT Online Proce	ess Data	
View Offline Online	State Machine		
Show Topology	Init	Safe-Op Bootstrap	
	Pre-Op O	Op Clear Error	
	Current State:	P	7
	Requested State: O	P	
	Crc Error Counters		
	Port A: 0	Port D: 0	
	Port B: 0	Port C: 0	
	EtherCAT Online Proce	ess Data 8	
	Name	Online	Type ^
	Input Diagnostics proces		10
	🔸 Input Byte 0	0×00 (0)	
		9 0x00 (0)	USINT
	✓ Input Byte 2 ✓ Input Byte 3	0×00 (0) 0×00 (0)	USINT USINT
	 Input Byte 4 	0x00 (0)	USINT
	 Input Byte 5 	0×00 (0)	USINT
	✓ Input Byte 6	0x00 (0)	USINT
	\star Input Byte 7	0×00 (0)	USINT
	🕶 Input Byte 8	0×00 (0)	USINT
	📌 Input Byte 9	0×00 (0)	USINT 🗸
	<		>





7.2 OVERALL STATUS DIAGNOSTICS

- VR10 / VR15 valve island module status will be shown in real-time.
- The diagnostic module status includes:
 - Over voltage diagnostics for valve power
 - Under voltage diagnostics for valve power
 - Over voltage diagnostics for electronic power
 - Under voltage diagnostics for electronic power
 - Cycle overrun diagnostics (cycles beyond the count limit)
 - Short circuit diagnostics
 - Open load diagnostics (e.g. wire break of solenoid)
- Fault error codes will be reported by "Input Byte 0".
- Fault error codes are displayed in hexadecimal and decimal.
- Common fault error codes are shown below:

Fault type	Error code	Associated	LED & Remark		
Over voltage diagnostics for valve power	004 (1)				
Abbreviation: OV-VA	0x01 (1)	"VA" LED, red	Donformance tested		
Under voltage diagnostics for valve power		<i></i>			
Abbreviation: UV-VA	0x02 (2)	"VA" LED, flashing red			
Over voltage diagnostics for electronic power					
Abbreviation: OV-VB	0x04 (4)	"VB" LED, red	EtherCAT Conformance tested		
Under voltage diagnostics for electronic power		<i></i>			
Abbreviation: UV-VB	0x08 (8)	"VB" LED, flashing red	Conformance tested		
Cycle overrun diagnostics	0.40(40)				
Abbreviation: COR	0x10 (16)	Count cycles are beyond t	he count limit (Section 6.3.2)		
Short circuit diagnostics	0,00,(00)	o " oos			
Abbreviation: SC	0x20 (32)	Section 6.3.5			
Open load diagnostics	0.40.(04)	N			
Abbreviation: OC	0x40 (64)	Need to enable open load diagnostics (Section 6.3.3)			





 Binary value and fault type mapping relationships are shown in the table below. 0 is no fault, 1 is fault found.

Input Byte 0								
Fault type		OC	SC	COR	UV-VB	OV-VB	UV-VA	OV-VA
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1





7.3 CHANNEL DIAGNOSTICS

- VR10 / VR15 valve island channel status will be shown in real-time.
- The diagnostic channel status includes:
 - Short circuit diagnostics per solenoid
 - Open load diagnostics per solenoid (e.g. wire break of solenoid)
 - Cycle overrun diagnostics per solenoid (cycles beyond the count limit)

7.3.1 Short Circuit Diagnostics

- Short circuit fault error codes will be reported by "Input Byte 1", "Input Byte 2" and "Input Byte 3".
- Fault error codes are displayed in hexadecimal and decimal.
- Common short circuit fault error codes are shown in table:

Byte	Solenoid	Error code
	Sol.01	0x01 (1)
	Sol.02	0x02 (2)
	Sol.03	0x04 (4)
Input Byte 1	Sol.04	0x08 (8)
	Sol.05	0x10 (16)
	Sol.06	0x20 (32)
	Sol.07	0x40 (64)
	Sol.08	0x80 (128)
	Sol.09	0x01 (1)
	Sol.10	0x02 (2)
	Sol.11	0x04 (4)
Input Byte 2	Sol.12	0x08 (8)
input byto 1	Sol.13	0x10 (16)
	Sol.14	0x20 (32)
	Sol.15	0x40 (64)
	Sol.16	0x80 (128)
	Sol.17	0x01 (1)
	Sol.18	0x02 (2)
	Sol.19	0x04 (4)
Input Byte 3	Sol.20	0x08 (8)
input Dyte e	Sol.21	0x10 (16)
	Sol.22	0x20 (32)
	Sol.23	0x40 (64)
	Sol.24	0x80 (128)





 Binary value and solenoid number mapping relationships are shown in the table below. 0 is no fault, 1 is fault found.

Input Byte 1									
Solenoid	Sol.08	Sol.07	Sol.06	Sol.05	Sol.04	Sol.03	Sol.02	Sol.01	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	

Input Byte 2									
Solenoid	Sol.16	Sol.15	Sol.14	Sol.13	Sol.12	Sol.11	Sol.10	Sol.09	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	

	Input Byte 3								
Solenoid	Sol.24	Sol.23	Sol.22	Sol.21	Sol.20	Sol.19	Sol.18	Sol.17	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	



7.3.2 Open Load Diagnostics

- Open load fault error codes will be reported by "Input Byte 4", "Input Byte 5" and "Input Byte 6".
- Fault error codes are displayed in hexadecimal and decimal.
- To enable open load diagnostics refer to Section 6.3.3.
- Common open load fault error codes are shown in table below:

Byte	Solenoid	Error code
	Sol.01	0x01 (1)
	Sol.02	0x02 (2)
	Sol.03	0x04 (4)
Input Byte 4	Sol.04	0x08 (8)
	Sol.05	0x10 (16)
	Sol.06	0x20 (32)
	Sol.07	0x40 (64)
	Sol.08	0x80 (128)
	Sol.09	0x01 (1)
	Sol.10	0x02 (2)
	Sol.11	0x04 (4)
Input Byte 5	Sol.12	0x08 (8)
par byte e	Sol.13	0x10 (16)
	Sol.14	0x20 (32)
	Sol.15	0x40 (64)
	Sol.16	0x80 (128)
	Sol.17	0x01 (1)
	Sol.18	0x02 (2)
	Sol.19	0x04 (4)
Input Byte 6	Sol.20	0x08 (8)
input byto o	Sol.21	0x10 (16)
	Sol.22	0x20 (32)
	Sol.23	0x40 (64)
	Sol.24	0x80 (128)





 Binary valueand solenoid number mapping relationships are shown in the table below. 0 is no fault, 1 is fault found.

Input Byte 4								
Solenoid	Sol.08	Sol.07	Sol.06	Sol.05	Sol.04	Sol.03	Sol.02	Sol.01
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1

Input Byte 5								
Solenoid	Sol.16	Sol.15	Sol.14	Sol.13	Sol.12	Sol.11	Sol.10	Sol.09
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1

	Input Byte 6								
Solenoid	Sol.24	Sol.23	Sol.22	Sol.21	Sol.20	Sol.19	Sol.18	Sol.17	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	





7.3.3 Cycle Overrun Diagnostics

- Cycle overrun fault error codes will be reported by "Input Byte 7", "Input Byte 8" and "Input Byte 9".
- Fault error codes are displayed in hexadecimal and decimal.
- It is necessary to set valid count limit so that this diagnostic function is effective (Section 6.3.2).
- Common cycle overrun fault error codes are shown in table:

Byte	Solenoid	Error code
	Sol.01	0x01 (1)
	Sol.02	0x02 (2)
	Sol.03	0x04 (4)
Input Byte 7	Sol.04	0x08 (8)
	Sol.05	0x10 (16)
	Sol.06	0x20 (32)
	Sol.07	0x40 (64)
	Sol.08	0x80 (128)
	Sol.09	0x01 (1)
	Sol.10	0x02 (2)
	Sol.11	0x04 (4)
Input Byte 8	Sol.12	0x08 (8)
input byte o	Sol.13	0x10 (16)
	Sol.14	0x20 (32)
	Sol.15	0x40 (64)
	Sol.16	0x80 (128)
	Sol.17	0x01 (1)
	Sol.18	0x02 (2)
	Sol.19	0x04 (4)
Input Byte 9	Sol.20	0x08 (8)
input byte o	Sol.21	0x10 (16)
	Sol.22	0x20 (32)
	Sol.23	0x40 (64)
	Sol.24	0x80 (128)





 Binary value and solenoid number mapping relationships are shown in the table below. 0 is no fault, 1 is fault found.

	Input Byte 7								
Solenoid	Sol.08	Sol.07	Sol.06	Sol.05	Sol.04	Sol.03	Sol.02	Sol.01	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	

	Input Byte 8								
Solenoid	Sol.16	Sol.15	Sol.14	Sol.13	Sol.12	Sol.11	Sol.10	Sol.09	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	

	Input Byte 9								
Solenoid	Sol.24	Sol.23	Sol.22	Sol.21	Sol.20	Sol.19	Sol.18	Sol.17	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
Binary value	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	0 / 1	



8 DIAGNOSTICS & OUTPUTS MAPPING OBJECT

• Programming languages comply with IEC 61131-3:2013.

Overall				Inpu	ut Byte 0						
status diagnostics	Fault type	\frown	OC	SC	COR	UV-VB	OV-VB	UV-VA	OV-VA		
ulaynostics	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
				Inpu	ut Byte 1						
	Solenoid Bit	Sol.08 Bit 7	Sol.07 Bit 6	Sol.06 Bit 5	Sol.05 Bit 4	Sol.04 Bit 3	Sol.03 Bit 2	Sol.02 Bit 1	Sol.01 Bit 0		
Short				Inpu	ut Byte 2						
circuit diagnostics	Solenoid	Sol.16	Sol.15	Sol.14	Sol.13	Sol.12	Sol.11	Sol.10	Sol.09		
	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
				Inpu	ut Byte 3						
	Solenoid	Sol.24	Sol.23	Sol.22	Sol.21	Sol.20	Sol.19	Sol.18	Sol.17		
	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
				Inpu	ut Byte 4						
	Solenoid	Sol.08	Sol.07	Sol.06	Sol.05	Sol.04	Sol.03	Sol.02	Sol.01		
	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
Open load		Input Byte 5									
diagnostics	Solenoid	Sol.16	Sol.15	Sol.14	Sol.13	Sol.12	Sol.11	Sol.10	Sol.09		
	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
	Input Byte 6										
	Solenoid	Sol.24	Sol.23	Sol.22	Sol.21	Sol.20	Sol.19	Sol.18	Sol.17		
	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
				Inpu	ut Byte 7						
	Solenoid	Sol.08	Sol.07	Sol.06	Sol.05	Sol.04	Sol.03	Sol.02	Sol.01		
	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
Cycle											
overrun diagnostics	Solenoid	Sol.16	Sol.15	Sol.14	Sol.13	Sol.12	Sol.11	Sol.10	Sol.09		
alugnostics	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
				Inpu	ut Byte 9						
	Solenoid	Sol.24	Sol.23	Sol.22	Sol.21	Sol.20	Sol.19	Sol.18	Sol.17		
	Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		



	Output Byte 0								
Solenoid	Sol.08	Sol.07	Sol.06	Sol.05	Sol.04	Sol.03	Sol.02	Sol.01	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
			C	Dutput Byte	1				
Solenoid	Sol.16	Sol.15	Sol.14	Sol.13	Sol.12	Sol.11	Sol.10	Sol.09	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
			C	Output Byte	2				
Solenoid	Sol.24	Sol.23	Sol.22	Sol.21	Sol.20	Sol.19	Sol.18	Sol.17	
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	





9 LED STATUS DESCRIPTION



Symbol	LED Status	Description
	Off	Valve island in INIT state
RUN	Flashing green	Valve island in PREOP state
KUN	Flashing green with longer pause	Valve island in SAFEOP state
	Green on	Valve island in OP state
	Off	Link Connection Not Established
L/A 1	Green on	Link Connection Established
	Flashing green	Link Communication Active
	Off	Link Connection Not Established
L/A 2	Green on	Link Connection Established
	Flashing green	Link Communication Active
VA	Green on	Voltage OK
	Flashing red	Undervoltage
(Valve Power Supply)	Red	Overvoltage
VB	Green on	Voltage OK
VB	Flashing red	Undervoltage
(Electronics Power Supply)	Red	Overvoltage



10 TECHNICAL DATA EtherCAT INTERFACE

Specification		Remark
Number of ports	2	
Transfer speed	100Mbit/s	
Duplex mode	Full Duplex	
EtherCAT mode	Direct Mode (No MAC address)	
DC mode	Supported	Distributed clocks
Conformance test record	1.2.8	
Addressing mode	Manual setting is not required, automatically set	
ESI Language	EN	



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